CLAIMS

1. A stirling engine comprising;

a cylinder,

a piston reciprocating inside the cylinder while keeping an air-tight condition between the piston and the cylinder by means of a gas bearing, and

a linear approximation mechanism coupled directly or indirectly to the piston to make an approximately linear motion when the piston reciprocates inside the cylinder.

2. The stirling engine according to claim 1, further comprising;

a crankshaft rotating around a driving shaft;

an extension extending downward from the piston; and

a connecting rod coupling the extension and the crankshaft,

wherein the linear approximation mechanism is coupled to a coupling element between the extension and the connecting rod to control movement of the coupling element so that the coupling element makes an approximately linear motion along an axial centerline of the cylinder.

3. The stirling engine according to claim 2, wherein the piston and the extension are rotatably connected to one another.

4. The stirling engine according to claim 2, wherein the linear approximation mechanism is configured so that a first deviation of the coupling element from the axial centerline of the cylinder at an upper dead point of the piston is smaller than a second deviation of the coupling element from the axial centerline of the cylinder at a

lower dead point of the piston.

5. The stirling engine according to any one of claims 1 to 4, wherein the linear approximation mechanism is a grasshopper mechanism.

6. The stirling engine according to any one of claims 2 to 4, wherein

the linear approximation mechanism is a grasshopper mechanism,

the grasshopper mechanism includes,

first and second lateral links, and

a longitudinal link,

wherein a first end of the first lateral link is rotatably coupled to the coupling element between the extension and the connecting rod,

a second end of the fist lateral link is rotatably coupled to a first end of the longitudinal link,

a second end of the longitudinal link is rotatably fixed to a predetermined position of the stirling engine,

a first end of the second lateral link is rotatably coupled to the first lateral link at a predetermined position in the middle of the first lateral link, and

a second end of the second lateral link is rotatably fixed to the stirling engine at a predetermined position.

7. The stirling engine according to claim 6, wherein in the grasshopper mechanism,

the first end of the second lateral link has a two-forked structure having two folk ends, and

the first end of the first lateral link is configured to pass between the folk ends.

8. The stirling engine according to claim 6, wherein in the grasshopper mechanism, the first end of the first lateral link and the coupling element between the extension and the connecting rod are coupled by means of a single piston pin.

9. The stirling engine according to claim 6, wherein

in the grasshopper mechanism, among the first end of the first lateral link, an end of the extension at the coupling element between the extension and the connecting rod, and an end of the connecting rod, two ends have a two-forked structure having two fork ends, and

the end of the remaining one of the three ends is disposed between the two fork ends of two other ends.

10. The stirling engine according to claim 1, further comprising:

a crankshaft which rotates; and

a connecting rod coupling the crankshaft and the piston,

wherein the linear approximation mechanism has

a first lateral arm,

a second lateral arm, and

a linearly moving guide,

wherein the first lateral arm is disposed so that the first lateral arm intersects with the connecting rod and is rotatable around a supporting point placed between the piston and the crankshaft, at a position offset relative to an axial centerline of the cylinder, and

the second lateral arm has first and second ends,

wherein at the first end, a first locomotive coupling point which linearly reciprocates is placed, and

at the second end, a second locomotive coupling point

which is coupled to the piston is placed,

between the first locomotive coupling point and the second locomotive coupling point, a third locomotive coupling point is placed,

at the third locomotive coupling point, an end of the first lateral arm opposite to the supporting point is rotatably coupled, and

the linearly moving guide supports the first locomotive coupling point and guides the first locomotive coupling point as to make a linear motion.

11. The stirling engine according to claim 10, wherein

the linearly moving guide comprises a cylindrical guide and a slider piston that slides inside the cylindrical guide, and

the linearly moving guide has a function of serving as a compressor that compresses the gas inside the cylindrical guide by means of the reciprocating motion by the slider piston inside the cylindrical guide.

12. The stirling engine according to claim 11, comprising:

a plurality of the pistons and

a plurality of the linear approximation mechanisms disposed corresponding to the plurality of the pistons, respectively,

wherein a plurality of the compressors are provided corresponding to the plurality of the linear approximation mechanisms, respectively, and

the compressors are connected in line so that the compressors increase the pressure applied to the gas in steps.

13. The stirling engine according to claim 12, wherein a

discharge from the subsequent compressor is smaller than a discharge from the previous compressor.

14. The stirling engine according to any one of claims 10 to 13, further comprising

a housing disposed with at least the crankshaft enclosed inside,

wherein the inside of the housing is pressurized by means of the compressor.

15. A hybrid system comprising:

the stirling engine according to any one of claims 1 to 4, and

an internal combustion engine of a vehicle,

wherein the stirling engine is mounted on the vehicle and,

a heater of the stirling engine is arranged to draw heat from an exhaust system of the internal combustion engine.

16. A piston mechanism, comprising:

a cylinder;

a piston reciprocating inside the cylinder while keeping an air-tight condition between the cylinder and the piston by means of a gas bearing;

a rotatable crankshaft;

a connecting rod coupling the crankshaft and the piston; and

a linear approximation mechanism coupled directly or indirectly to the piston and disposed so that the piston makes approximately linear motion when the piston reciprocates inside the cylinder.

17. A piston engine, comprising:

a cylinder;

a piston reciprocating inside the cylinder while keeping an air-tight condition between the piston and the cylinder by means of a gas bearing;

a rotatable crankshaft;

a connecting rod coupling the crankshaft and the piston;

a first lateral arm;

a second lateral arm; and

a linearly moving guide,

wherein the first lateral arm is disposed so that the first lateral arm intersects with the connecting rod and make rotational motion around a supporting point placed between the piston and the crankshaft and at a position offset relative to an axial centerline of the cylinder,

the second lateral arm has first and second ends,

at the first end, a first locomotive coupling point that linearly reciprocates is placed,

at the second end, a second locomotive coupling point is coupled to the piston,

between the first locomotive coupling point and the second locomotive coupling point, a third locomotive coupling point is placed,

at the third locomotive coupling point, an end of the first lateral arm opposite to the supporting point is rotatably coupled, and

the linearly moving guide supports the first locomotive coupling point and guides the first locomotive coupling point so that the first locomotive coupling point makes linear motion.

18. The piston engine according to claim 16 or 17, wherein

the piston engine is a stirling engine and working fluid fed from a heat exchanger having a heater, a regenerator, and a cooler is introduced into the cylinder to drive the piston.

19. The piston engine according to claim 18, wherein at least the heater of the heat exchanger is disposed on an exhaust pathway of the internal combustion engine to recover heat exhausted from the internal combustion engine.

20. The piston engine according to claim 16 or 17, wherein the linearly moving guide has a cylindrical guide and a slider piston sliding inside the cylindrical guide, and the linearly moving guide has a function as a compressor which compresses a gas inside the cylindrical guide by means of reciprocating motion by the slider piston inside the cylindrical guide.